GREAT BAY COAST WATCH
A CITIZEN WATER MONITORING PROGRAM

VOLUNTEER WATER QUALITY MONITORING MANUAL
2004

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UNHMP-M-SG-04-02

Great Bay Coast Watch

Mission Statement

The Great Bay Coast Watch is citizen volunteers, working within the UNH Cooperative Extension / NH Sea Grant College Program, protecting the long-term health and natural resources of New Hampshire's coastal waters and estuarine systems through monitoring and education projects.

The University of New Hampshire's Cooperative Extension has provided funding in support of the Great Bay Coast Watch's work and the publishing of this manual. The University of New Hampshire Cooperative Extension is an equal opportunity educator and employer, US Department of Agriculture and NH counties cooperating.

This publication was supported by the National Sea Grant College Program of the US Department of Commerce's National Oceanic and Atmospheric Administration under NOAA Grant No. NA16RG1035. The views expressed herein do not necessarily reflect the views of any of these organizations.

This manual was funded in part by a grant from the Office of Energy and Planning, New Hampshire Estuaries Project, as authorized by the U.S. Environmental Protection Agency pursuant to Section 320 of the Clean Water Act.

This manual was also supported by a grant from the Office of Energy and Planning, New Hampshire Coastal Program, as authorized by the National Oceanic and Atmospheric Administration (NOAA), Grant No. NA170Z2324.

ACKNOWLEDGMENTS

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The volunteer monitors in the Great Bay Coast Watch must be recognized and gratefully acknowledged, for it is through their efforts that we all better understand and appreciate the Great Bay Estuarine System and the New Hampshire Atlantic Coast.

Photo: The site 6 Fox Point sampling team: Barbara Hill, Sam, Michele and Sophie Wensman and Bill Macklin

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1.0 INTRODUCTION

1.1 Purpose

The purpose of this document is to present step-by-step instructions for conducting water quality testing in support of the Great Bay Coast Watch (GBCW). As you use these procedures, please note any errors or suggestions and report them to Ann Reid, GBCW Coordinator, at (603) 749-1565.

1.2 GBCW Mission

The Great Bay Coast Watch is citizen volunteers, working within the UNH Cooperative Extension/NH Sea Grant Program, protecting the long-term health and natural resources of New Hampshire's coastal waters and estuarine systems through monitoring and education projects.

1.3 GBCW Background

Great Bay Coast Watch is New Hampshire's most wide-ranging program for direct citizen involvement in monitoring estuarine and coastal waters. Its volunteers is comprised of adults from all occupations, as well as students and teachers from local schools. GBCW was formed as Great Bay Watch in 1990, with funding from NOAA, in response to the Great Bay National Estuarine Research Reserve Management Plan, which listed the formation of a citizen estuarine monitoring program as one of its objectives. GBCW has been a part of the educational efforts of UNH Cooperative Extension/NH Sea Grant Programs of the University of New Hampshire for the since 1990. In 1999, to more accurately reflect a growing involvement of our volunteers in coastal shoreline surveys and phytoplankton monitoring projects, "Coast" was added to the name. The number of monitors has tripled since 1990, and the GBCW now samples more than twice as many sites as when it began. We have continued our dedication to monitoring projects on the NH Seacoast through another season of phytoplankton monitoring, participation in rainfall runoff characterization studies in Great Bay and the Bellamy River, and an instream study for habitat assessment. GBCW assisted the New Hampshire Estuaries Project (NHEP), the New Hampshire Department of Environmental Services (NHDES) Shellfish Program, the New Hampshire Coastal Program (NHCP), and the City of Dover in protecting the health and natural resources of Great Bay, the Atlantic coastline, and Hampton Harbor.

The GBCW has three specific goals:

1. To monitor the chemical, physical, and biological systems of the New Hampshire coastal waters and Great Bay Estuarine System.
2. To educate residents of New Hampshire's coastal and estuarine communities about the ecological status and protection of these systems.
3. To develop a management structure that engages volunteers in all aspects of the GBCW and continuously improves the quality of the monitoring and education projects.

A coordinator and extension specialist from UNH's Sea Grant/Cooperative Extension manages the GBCW. Currently, the GBCW has more than 100 active adult members. More than 300 adults have been members of the GBCW over the past 13 years, with 13 having been enrolled in the program since its inception. During the past 13 years, the monitors have driven thousands of miles and have given 131,500 volunteer hours to the program. Involvement of area schools has grown from one school in 1990, to eight by 2003. Portsmouth Middle School has been assigned a monitoring kit and has regularly sampled since 1999. Newmarket High School teachers and students rejoined the program in 2002.

1.4 New Hampshire Estuaries

"New Hampshire has over 230 miles of sensitive inland tidal shoreline in addition to 18 miles of open ocean coastline on the Fulf of Maine. New Hampshire's estuaries contain bays, tidal rivers and salt marsh systems. The coastal watershed that drains water into New Hampshire's estuaries via rivers and strams spans three states and approximately 80% of it is located in New Hampshire. Forty-two New Hampshire communities are entirely or partially located within the coastal watershed. The largest estuariesin the system include Great Bay and Hampton-Seabrook Harbor. Other estuaries of importance in the State are Little Bay, Little Harbor, Rye Harbor and portions of tidal tributaries.

Great Bay - The Great Bay is a tidally dominated, complex embayment on the New Hampshire-Maine border. Estuarine tidal waters cover 17 square miles with nearly 150 miles of tidal shoreline. Land surrounding the Bay includes steep, wooded banks with rocky outcrops, cobble and shale beaches and salt marshes. The estuary extends inland from the moutyh of the Piscataqua River between Kittery, ME and New Castle, NH to Great Bay proper, a distance of 15 miles. Great Bay's tidal exchange with the ocean generates rapid currents and keeps the estuary well mixed."

"Hampton-Seabrook Harbor - Hampton-Seabrook Harbor encompasses 480 acres of open water at high tide. Characterized by extensive salt marshes and spearated from the ocean by a series of barrier beaches, the approximately 8 square miles of contiguous salt marsh within the Hampton-Seabrook Harbor is the largest salt marsh in the State. It is also one of the busiest tourist venues because of Hampton Beach and the productive clam flats in the harbor.

New Hampshire's estuaries are dynamic, complex systems that greatly influence the Seacoast's economy, communities, quality of life and environment."[1]

Figure 1.4-1: Map of the Great Bay Estuary and GBCW Monitoring Sites

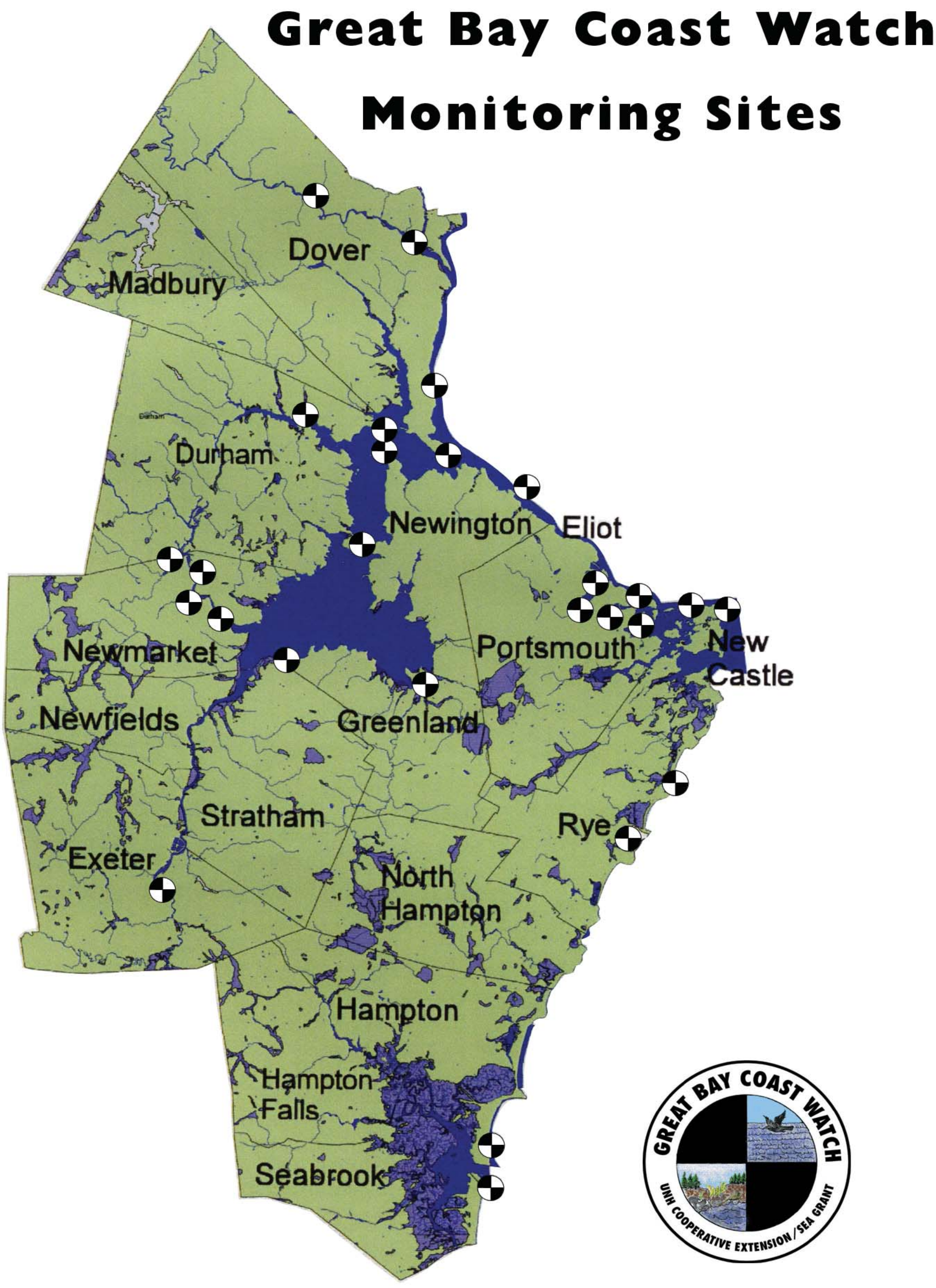


Figure 1.4-2: Table of Great Bay Coast Watch Sites

Site Name	Site #	Location	Town	1st Yr	Comments
Peninsula	1	Oyster River	Durham	1990	
JEL	2	Great Bay	Durham	1990	
Lamprey River	3	Lamprey River	Newmarket	1990	
Depot Road	4	Great Bay	Greenland/ Stratham	1990	High tide only as of 1993
PCC	5	Winnicut River	Greenland/ Stratham	1990	
Fox Point	6	Little Bay	Newington	1990	
Cedar Point	7	Little Bay	Durham	1990	
Rakoskes'	8	Piscataqua River	Dover	1990	Inactive as of 1992
Neal's	9	Cochecho River	Dover	1990	
Clark's	10	Piscataqua River	Dover	1991	
CML	11	Piscataqua River	New Castle	1991	
STP	12	Lamprey River	Newmarket	1992	
Marina Falls Land.	13	Lamprey River	Newmarket	1992	
Fowler's	14	Lamprey River	Newmarket	1992	
Patten Yacht Yard	15	Piscataqua River	Eliot, Me	1993	
Exeter Docks	16	Squamscott River	Exeter	1994	
Dover Foot-Bridge	17	Cochecho River	Dover	1996	
Maplewood Ave.	18	North Mill Pond	Portsmouth	1997	
Bartlett Ave.	19	North Mill Pond	Portsmouth	1997	
Junkins Ave.	20	South Mill Pond	Portsmouth	1997	
Pleasant Ave.	21	South Mill Pond	Portsmouth	1997	
Little Harbor	22	Little Harbor	Portsmouth	1998	High tide only

Photo: Ken Hawkins, a teacher at Portsmouth Middle School, at site 20 South Mill Pond

1.5 Why and How To Monitor?

Ecological monitoring can be defined as repetitive measurements or observations recorded over time for determining a condition or tracking change. A number of scientific studies point to the necessity of doing long-term ecological monitoring before drawing conclusions as to the cause and effect of observed changes. Changes are often gradual and subtle. The question is whether they represent trends. For example, is the apparent sea level rise due to warming of earth's atmosphere or just a natural fluctuation? In general, these studies have shown that:

1. Complex ecological systems require long-term observation and study for understanding;

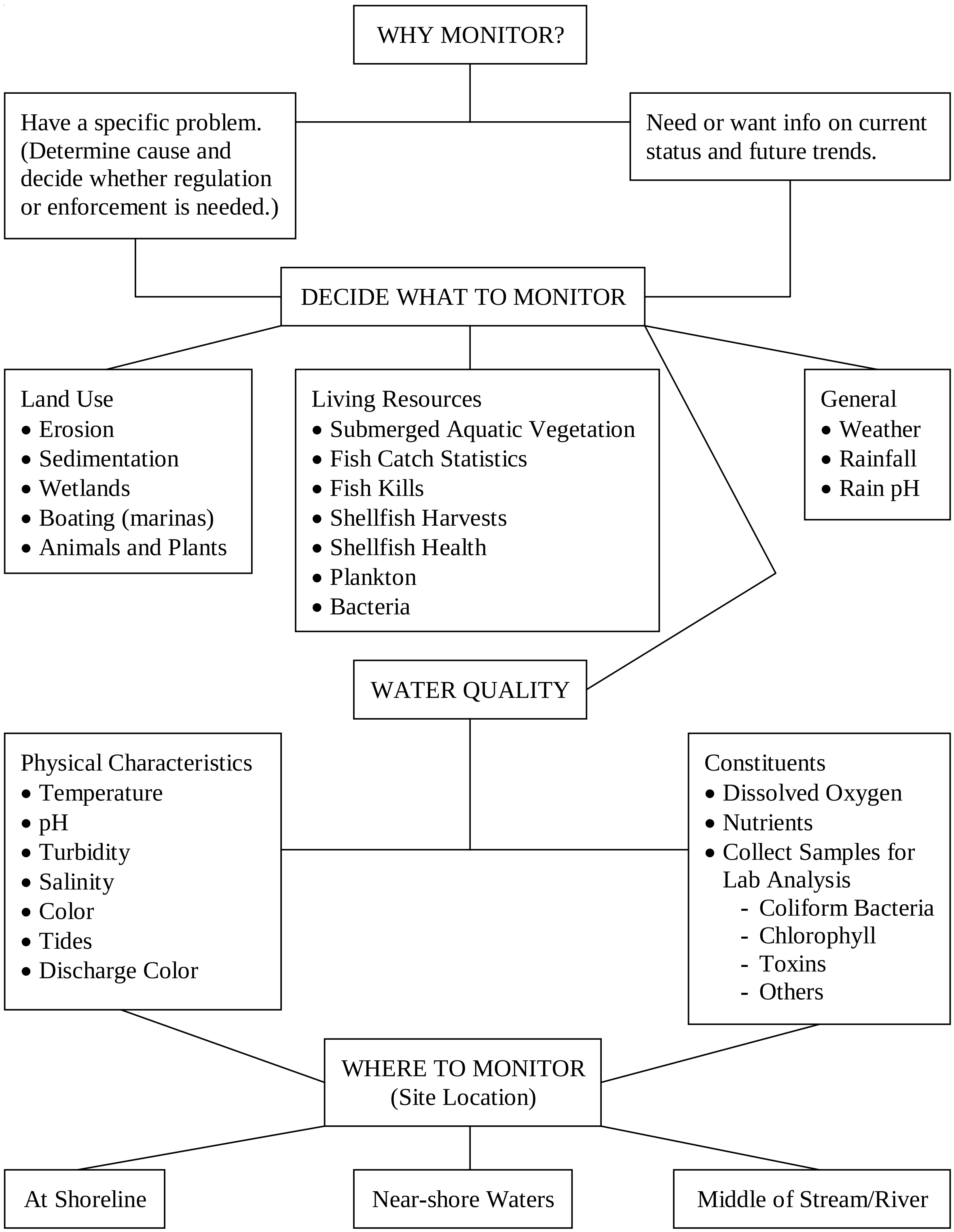
2. A sequence of only two to three years of data can be very misleading about trends in environmental quality; and

3. Environments have a "memory" or response time which varies greatly. It takes a certain amount of time to detect a change – perhaps a decade for lakes and streams, and a century for soil.

The general methodology for choosing sites to monitor and the information to record is illustrated in Figure 1.5-1. While those involved in citizen monitoring efforts are usually not trained scientists, they can, with relatively little training and simple equipment, collect information that will contribute to an ecological study of the site they are investigating. Data collected at GBCW sites form a vital part of the ecological picture of the Great Bay Estuary.

Figure 1.5-1: Why and How to Monitor?

This organizational chart is a decision making matrix used for selecting what type of monitoring is useful and necessary. This is the process followed in selecting the Great Bay Estuary for water quality monitoring by the GBCW.



1.6 GBCW Monitoring Process

1.6.1 Philosophy

It is very important that the data collected by GBCW volunteers be accurate and consistent. To achieve this, GBCW provides each volunteer with the necessary training, equipment and procedures needed to do the job. In return GBCW expects each volunteer to make a minimum two-year (and hopefully much longer) commitment to the monitoring program.

To maximize the accuracy and consistency of the data, GBCW protocols incorporate some essential elements of the scientific method. The goal is to remove any biases or prejudices which could impact the validity of the data. To achieve this, GBCW does the following:

- Develops and maintains correct procedures.
- Trains volunteers in these procedures.
- Callibrates equipment periodically.
- Provides monthly meetings which offer a forum for volunteers to communicate and usually feature a guest speaker.
- Conducts twice-per-year Quality Assurance Quality Control (QAQC) testing of all volunteers.

The semi-annual QAQC testing is mandatory and comprises a full exercise of all tests by each volunteer under the supervision of expert water quality personnel. Certification of each volunteer is important for validating our program in accordance with organizations such as the Environmental Protection Agency (EPA). The goal of QAQC testing also ensures volunteers are using the proper methodology and allows GBCW to offer corrective instruction if they are not. Any confusing aspects of these procedures will be corrected on a continuing basis.

1.6.2 Schedule

GBCW sampling is conducted monthly at the 21 sites listed in Figure 1.4-1. The sampling schedule is shown in Appendix A. For each date, sampling is conducted twice – at low tide and at high tide. Tidal times are also provided in Appendix A.

In addition to the monthly sampling, GBCW organizes or participates in the events listed in the schedule in Appendix B. These include:

- Semi-annual QAQC testing
- Monthly meetings held at Kingman Farm
- Summer barbecue/annual meeting at the Coast Guard Station in New Castle.
- Fall Chili and “Chowdah” Fest and season wrap-up meeting.
- Annual meeting
- Secchi Dip In Event
- United Way Day of Caring
- International Coastal Clean Up
- United Way Volunteer Service Day

Photos: 1) Beverly Brinkman at QAQC Session; 2) Ann Reid presents “Blue Mussel Award” to Dr. Richard Langan with Duane Hyde and 4th Annual Meeting and Barbecue; 3) Kaori Tsukui, Amber Perkins and Paul Kilian at Newmarket Heritage Festival; and 4) Ann Reid and Candace Dolan at Hilton Park for United Way Annual Coastal Cleanup.

1.7 Scope

The remainder of this instruction manual comprises nine sections, one section for each of the six test procedures sandwiched between a “Getting Started” section and a “Clean-Up” section.

2.0 GETTING STARTED

This section of the manual prepares you for conducting the sampling process. There is a checklist of the equipment and supplies that you will need, a summary of the procedures to be followed at the field site, a copy of the data sheet that you will use, and a description of safety considerations.

2.1 Equipment Checklist

Before going to the field, review the Equipment Checklist shown in Figure 2-1 to ensure that you have all the items needed for the sampling process in the field. If you followed the Section 10 Clean-Up procedures after last month's sampling, you will have already restocked and refurbished the kit as necessary. However, it doesn't hurt to check!

Photos: Sampling equipment prepared and in the field.

2.2 Sampling Procedure Order and Summary

This section is to clarify the order in which the sampling procedures should be performed. Please refer to the individual procedure sections for testing protocols.

A. Procedure at the water's edge:

1. Bring instruction manual.
2. Fill out data sheet heading completely. Record the numbers of the water thermometer, pH meter and hydrometer.
3. Put air thermometer in place. We suggest hanging it in a nearby bush out of the sun. Record temperature on data sheet after 15 minutes.

4. Take the sample of water in sterile bag for *Fecal coliform* bacteria test and place in cooler. Collecting this sample prior to performing other testing is important. Disturbing the water column may re-suspend *Fecal coliform* bacteria and produce a false reading.

5. Take the Secchi disk reading. Record on data sheet.

6. Take the water depth measurement. Record on data sheet.

7. Collect the water sample with the bucket.

8. Immediately immerse the armored thermometer to measure water temperature. Read it after 3 minutes. Record on data sheet.

9. While you are waiting for the temperature reading, draw off water for dissolved oxygen (D.O.) test into your BOD bottle. Complete steps 1-4 of the D.O. procedure.

Steps 10-17 may be completed at the water's edge or site lab.

10. Complete the pH testing.

11. Fill the hydrometer jar and immerse both the armored thermometer and the hydrometer in the jar. Read the thermometer after 3 minutes. Record the temperature on the data sheet. Read the hydrometer. Record the density on the data sheet.

12. Determine the salinity using the tables in your manual and the density reading.

13. Complete the dissolved oxygen titration protocol.

14. Wash all the equipment that was in contact with chemicals or salt water after every test. Dry everything thoroughly, including the inside of the bucket. Salt water quickly corrodes the equipment and cleaning will help prevent deterioration.

15. Complete data sheet:

    a) Weather, Water, Activity, and Observation Narrative.

    b) Record the time and mileage of each volunteer, including the names of each student present, and have data sheet signed by a member of the site team who has successfully completed a QAQC session. This signature is important as it validates the sampling data.

16. Complete the entries on the Cumulative Data Sheet and Time & Mileage Sheets.

17. Bring the water sample for fecal coliform bacteria testing to Kingman Farm before 6 p.m.

Figure 2.2-1: EQUIPMENT LIST

Site #_______ Site Name_______________________ Tool Box # _____

TEMPERATURE

__________ Air thermometer with string
__________ Armored water thermometer #______

SALINITY

__________ Hydrometer with case and stopper #_______ (inside paper on hydrometer stem)
__________ Hydrometer jar (plastic 500mL cylinder)

pH

__________ pH meter #______
__________ 6 small brown containters with caps: Count_______
__________ 1 small contianer of extra pH 7 buffer solution

DISSOLVED OXYGEN

__________ Graduated burette (2)
__________ Glass rods (2)
__________ BOD bottle (glass) and stopper (2)
__________ 100mL graduated cylinder
__________ Plastic beaker
__________ 1 box manganese sulfate pillows Count_________
__________ 1 box iodide-azide pillows Count_________
__________ 1 box sulfamic acid pillows Count_________
__________ 1 bottle starch solution
__________ 1 bottle of sodium thiosulfate
__________ 1 scissors
__________ 2 glass marbles

FECAL COLIFORM BACTERIA

__________ Collecting tongs
__________ Whirlpak bags (sterile) ______ (count)
__________ Permanent marker
__________ Ice pack
__________ Cooler container for samples

SAFETY ITEMS

__________ Container with sticker/emergency numbers
__________ Band-Aids and antiseptic
__________ Plastic container for tap water (for eyewash, pH test and clean-up)
__________ Protective glasses

WATER TRANSPARENCY

__________ Secchi disk with measured line attached

MISCELLANEOUS

__________ Clipboard with pencil attached
__________ Waste container (1 gallon plastic detergent container)
__________ Clean cloth for drying equipment
__________ GBCW manual and data sheets
__________ Water sample collection bucket with rope, tubing, clamp and spigot attached

I certify that I have reviewed the data entry on this form and that it is accurate and complete.

NAME (Please print) ____________________________________ **DATE** _____________

SIGNATURE ____ revised 12/23/03

2.3 The Field Data Sheet

The GBCW Field Data Sheet is shown in Figure 2-2. You should always maintain a supply of blank sheets for use in the field. Use the sheets as follows:

1. On the front, fill in the (1) names of the samplers, (2) day, date and military time the sample is collected, and (3) site number and name, as well as whether it is high tide or low tide.

2. Fill out the remaining parts on the front by recording data observations as you perform the various sampling procedures.

3. On the back, describe the conditions at your sampling site. Your comments regarding the weather and activities at the site during sampling time assist us in evaluating the data collected. Anything causing water conditions to change, such as animals present or strong current are of particular interest.

4. Fill in the name of the person collecting the sample for *Fecal coliform* testing, as well and the name of the person who is transporting the water sample to Kingman Farm.

5. Fill out the Birds and Horseshoe Crabs sections. If none of these animals are present, please put a zero in this space to indicate that you looked and none were found.

5. Once the sampling is completed, fill out the Time & Mileage Estimates section on the back for each person at the site, including students.

7. A QAQC certified member of the sampling team must sign and date the field data sheet and deliver the completed data sheet to GBCW at Kingman Farm.

An unsigned data sheet is considered invalid and cannot be used in the database.

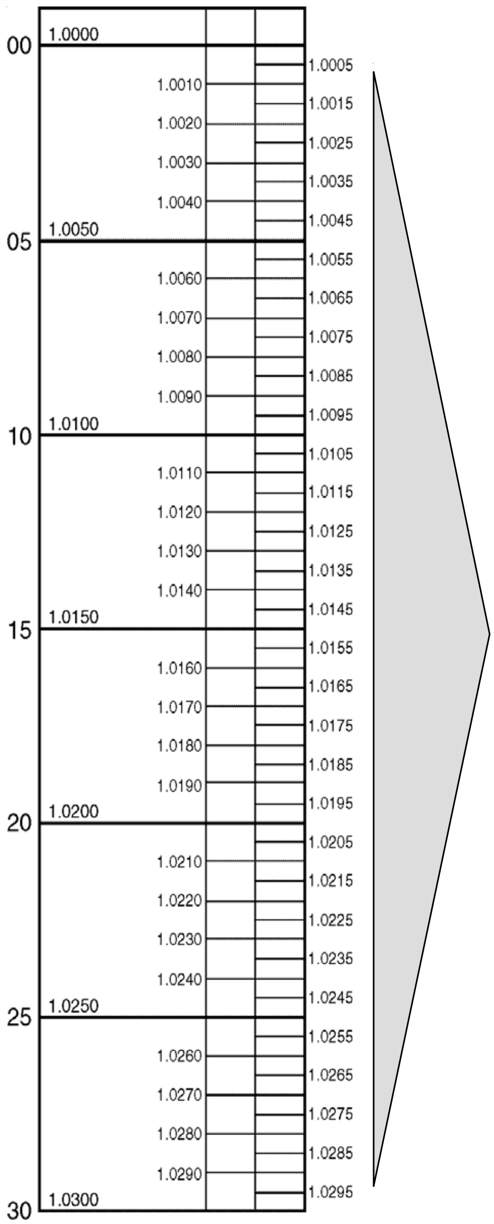
Photo: Barbara Balaguer, Audrey Fortin, Candace Dolan, Lydia Scott and Sam Wensman demonstrate that wearing protective glasses can be fun.

Figure 2.3-1: Front of Field Data Sheet

GREAT BAY COAST WATCH FIELD DATA SHEET

Sampling Team (full names please)
1. ______________________________
2. ______________________________
3. ______________________________
4. ______________________________

Day___________ **Date** ________
Tide _______ **Time** ___________
(H or L) **(Military)**
Site Number _________________
Site Name ___________________



Air Temperature ____________ **°C**

Water Transparency:
________**cm** ________**cm** ________**cm**
disappear **appear** **average**
Water Depth _________________**cm**

Water Temperature ___________ **°C**
Thermometer # ______________

Salinity:
Hydrometer # _______________
Water Temp (jar) _____________ **°C**
Density _______________ **g/cc**
Salinity ___________ **ppt (from chart)**

pH:
Meter # _____ **Reading** ________

Dissolved Oxygen:
Bottle # __________
Test 1 _______ **ml** **Test 2** _______ **ml**
Test 3 (only if diff > 0.3 ml) _______ **ml**
Total D.O. Reading __________ **mg/L**

(over)

revised 12/30/2003

Figure 2.3-1: Back of Field Data Sheet

GREAT BAY COAST WATCH FIELD DATA SHEET

Please describe the conditions at your site today:

Water: Calm _____ Ripple _____ Waves _____ Whitecaps ____

Weather: Clear___ Partly Cloudy ___ Overcast ___ Fog/Haze__
Showers ___ Downpour ___ Snow ___ Other ___________

Activities: Fishing ___ Oystering ___ Boating ___ Hunting ___
Other ____

Water for *Fecal coliform* Bacteria Testing:
Person taking sample ________________________________
Person transporting sample ___________________________

Birds: Type _______________ # ___
Type _______________ # ___
Type _______________ # ___

Horseshoe Crabs:
Total # seen: ________
young (< 2 in.): _____
amplexus: _________
laying eggs: _______

Please write an observation narrative:

____
____
____
____

Time & Mileage Estimates:

	Sampler 1	Sampler 2	Sampler 3
Field Work (Min):			
Lab Work (Min):			
Travel (Min):			
Total (Min):			
Mileage:			

FOR OFFICE USE ONLY

	Date	Initials
Reviewed		
Entered		
Accepted		

I certify that I have reviewed the data entry on this form and that it is accurate and complete.

Signature _________________________________ **Date** __________________
(QA/QC Qualified)

2.4 SAFETY FIRST

YOUR SAFETY IS PARAMOUNT

- Read all instructions to familiarize yourself with the sampling procedures before you begin. Note any precautions in the instructions.

- For your safety and good data recording, you must work with at least one partner.

- Note that some of the reagents are caustic.

- Keep all equipment and reagent chemicals out of the reach of small children and animals.

PROTECT YOURSELF AND YOUR EQUIPMENT BY ADHERING TO THE FOLLOWING TECHNIQUES:

- Avoid contact between reagent chemicals and skin, eyes, nose and mouth.

- Wear safety goggles or glasses when handling the reagents.

- Use stoppers, not your fingers, to cover the bottles during shaking or mixing.

- Rinse and wipe up any reagent chemical spills, liquid or powder as they occur.

- Thoroughly rinse jars and bottles with fresh water before and after each use. Dry your hands and the outside of the bottles.

- Avoid prolonged exposure of equipment and reagents to direct sunlight. Keep reagents in a dark location, protected from extremes in temperatures.

In case of an accident or suspected poisoning, immediately call 1-800-562-8236, the Poison Control Center, New Hampshire. If a reagent gets into your eye or on your skin, irrigate the area immediately with fresh water. We have the details on the reagents we are using. See Appendix C, Material Safety Data Sheets.
Also notify Ann Reid at (603)749-3880 or Sharon Meeker at (603)659-5441 at home, or during office hours call the Kingman Farm GBCW office at (603)749-1565.

3.0 TEMPERATURE

3.1 Temperature Discussion

Although temperature is one of the easiest measurements to perform, it is one of the most important parameters to be considered. It dramatically affects the rates of chemical and biochemical reactions within the water. Many biological, physical, and chemical principles are temperature dependent. Among the most common of these are the solubility of compounds in sea water, the distribution and abundance of organisms living in the estuary, rates of chemical reactions, density, current movements, inversions and mixing. Since Great Bay and its tributaries are so shallow, their capacity to store heat over time is relatively small and water temperatures fluctuate considerably.

The temperature of surface and subsurface water usually differs. With increase in depth, the water generally becomes colder, producing a thermal stratification. Vertical temperature profiles are fairly predictable. During the spring and summer months, the surface waters are warmer than the deeper waters, due to the warmth of the sun. In the fall, the warming radiation of the sun begins to diminish. As the surface water cools, it increases in density. Once the surface water becomes colder and denser than the waters toward the bottom, it begins to sink and vertical mixing occurs. Wind and tide may speed up the process. This mixing action, or upwelling, can bring nutrients up from the bottom into higher water where more plants and organisms may use it to their advantage. During the winter, the water temperature becomes relatively constant from surface to bottom until March, when the process of surface warming begins again.

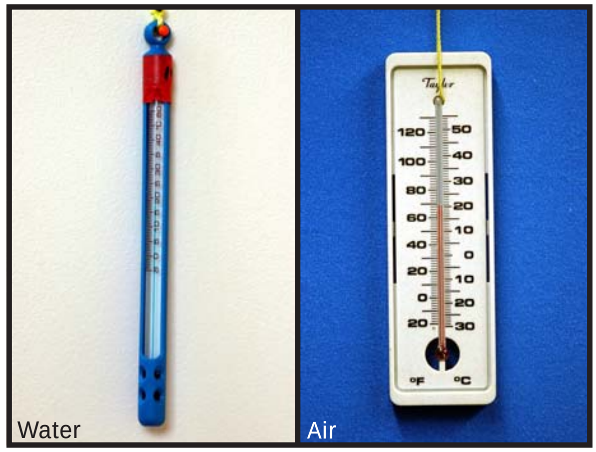
Temperature is reported on the field data sheet in degrees Celsius. You can make conversions from Fahrenheit to Centigrade or vice versa using the following formulas:

Fahrenheit to Centigrade:
Subtract 32 degrees from Fahrenheit temperature; divide by 9; multiply by 5.

Centigrade to Fahrenheit:
Divide Centigrade temperature by 5; multiply by 9; add 32.

3.2 Required Equipment for Temperature Testing

- Air thermometer
- Armored thermometer



Water Air

3.3 Temperature Procedure

Check thermometers for continuous fluid to ensure that no breaks are present.

A. Air Temperature

1. Place or hang the air thermometer out of the sun. Read after 15 minutes.

2. Record air temperature to the nearest whole degree, making sure to use Celsius scale. Convert from Fahrenheit, if necessary.

Thermometer in the shade.

B. Water Temperature

1. Rinse sampling bucket twice by filling it halfway and disposing of contents in an area away from the sampling spot (e.g., downstream). Let water flow through the tube in order to rinse it out and then clamp tube shut.

2. Collect water sample with bucket at a depth of one to two feet.

3. Hang armored thermometer in bucket and record reading after 3 minutes. Read this temperature within 5 minutes as the water temperature may change while sitting in the bucket. If too much time elapses, dispose of the water and collect another water sample.

4. When reading the thermometer, make sure the bottom of the thermometer remains in the water.

Keep thermometer in water when reading.

4.0 WATER TRANSPARENCY/SECCHI DISK

4.1 Water Transparency Discussion

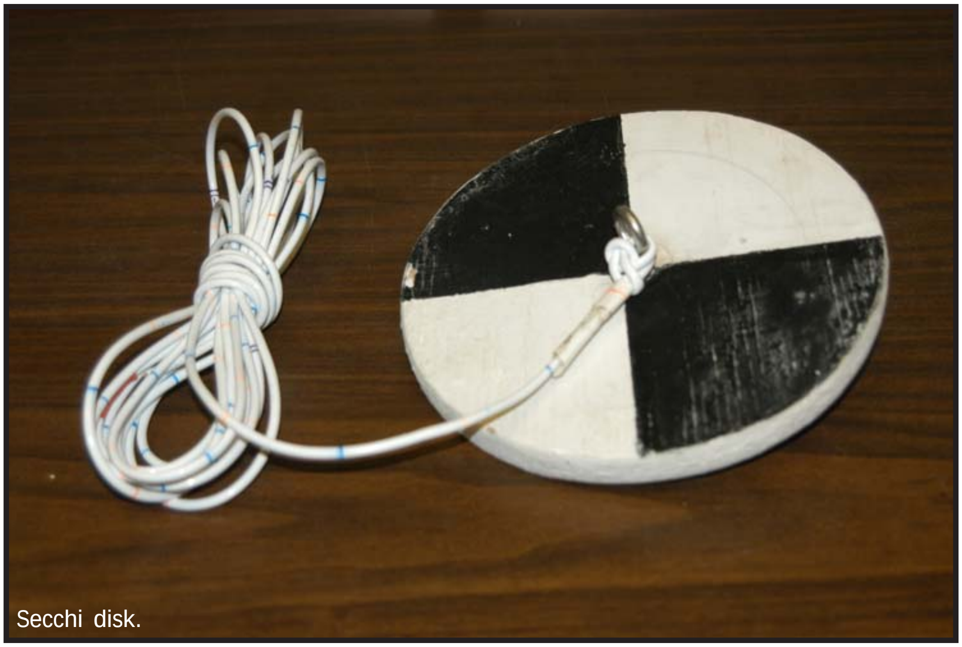
Transparency of water is a quick and easy measurement that integrates many important features of an aquatic system. Algae, microscopic animals, eroded soil, and re-suspended bottom sediment contained in the water column interfere with light penetration and lessen the transparency of the water. In late spring and early fall, transparency is usually reduced because of plankton and algal blooms. In the early spring, the water may become more turbid with silt being carried into the estuary with spring run-off. Since the sunlight is the basic energy source for all life, the degree of water transparency has an important effect on fish and aquatic life. Some effects are listed below:

- Limiting photosynthetic processes,
- Increasing plant respiration, oxygen use and the amount of carbon dioxide produced,
- Clogging of fish gills by suspended particles, and
- Obscuring vision of fish and shellfish as they hunt food.

Water color indicates transparency, to a degree, so it is useful to record the color.

4.2 Required Equipment for Water Transparency Testing

- Secchi disk with line marked every five centimeters



Secchi disk.

4.3 Water Transparency Procedure

Take transparency readings at the same spot each time. Stand with your back to the sun to shade the sampling spot. Do not wear a hat or sunglasses when taking these readings.

A. Water Transparency

1. Lower the Secchi disk into the water until it just goes out of sight. Note this depth the closest five centimeters and record as the “disappear” depth.

2. Raise Secchi disk until it just reappears. Note this depth to the closest five centimeters and record “reappear” depth.

3. Record the average of the two depths.

4. If the disk is resting on the bottom and is still visible, record the depth of the water for the average value.

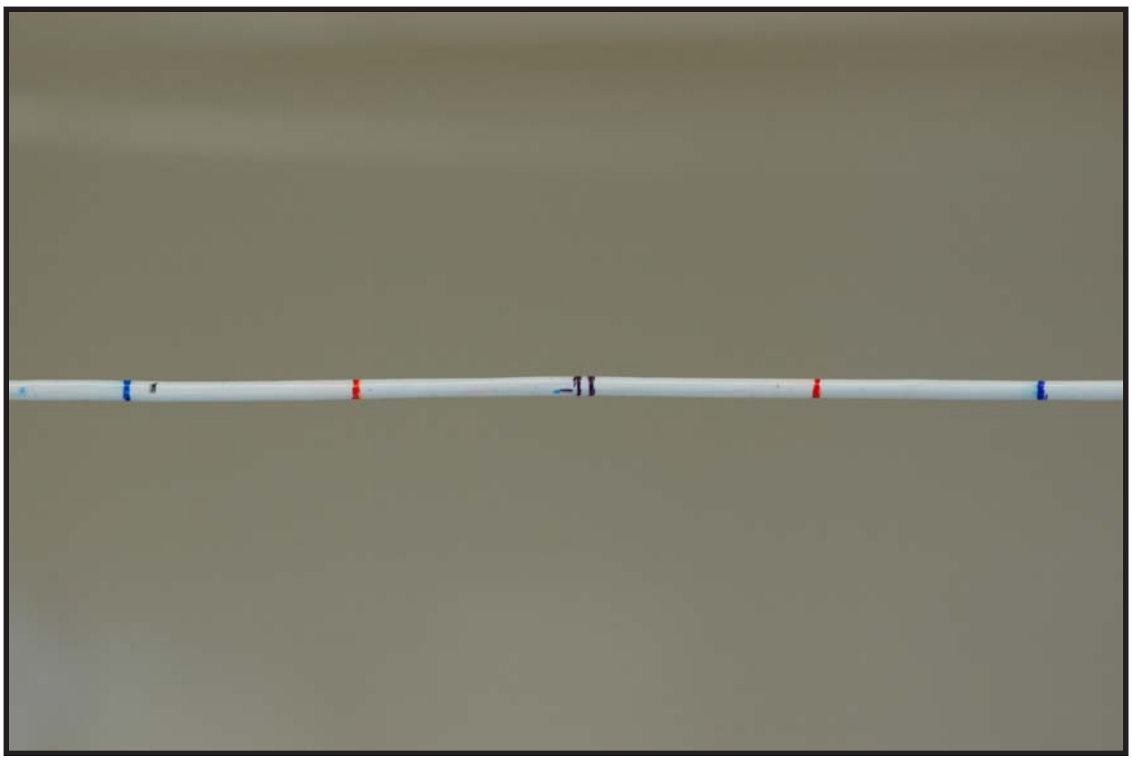
B. Water Depth

1. Lower the Secchi disk into the water until you feel or see the Secchi disk hit bottom. At this point the rope will go slack. Record the water depth to the closest 5 centimeters.

4.4 HOW TO READ THE SECCHI DISK DEPTH:

Begin measuring from the “surface” of the Secchi disk. From the “surface” up to the first BLUE mark is 10 centimeters (cm). The first RED mark is 15 cm from the “surface” of the Secchi disk. The marks on the line are at 5 cm intervals, alternating BLUE and RED. Ten BLUE marks represent 1 meter (m), which is represented by 2 BLACK marks.

Figure 4.4-1: Secchi Disk Line



5.0 pH

5.1 pH Discussion

pH is the measure of water alkalinity and acidity. The pH scale runs from zero to fourteen, acidic to basic, with 7.0 being neutral. The scale is logarithmic, which means that for each increase of one on the pH scale, acidity decreases by a factor of ten or alkalinity increases by a factor of ten. For example, at a pH of 4.0 there are ten times as many hydrogen ions as there are at a pH of 5.0, and so on. The pH of ocean water is slightly basic, usually at 8.0 to 8.4. In estuaries, the pH varies more, usually from 7.0 to 8.6, but can vary even more widely at times of extreme influx of fresh water or a high degree of biological activity. Water dissolves the mineral substances it contacts, picks up aerosols and dust from the air, receives wastes, and supports photosynthetic organisms, all of which affect pH. Salt water has a buffering capacity, which helps it resist pH change, but some change does occur. Generally, aquatic life can exist between pH of 9.0 and 5.0.

Figure 5-1: pH Scale of the pH of Some Common Substances

Very alkaline	14.0	
		Household lye
	13.0	
		Bleach
	12.0	
Ammonia		
	11.0	
Water softener	10.0	
Egg whites	9.0	Baking Soda
Salt water aquarium		Sea water
Swimming pool water	8.0	Blood
Fresh water aquarium		Distilled water
	7.0	Milk
Pure rain	6.0	Egg yolk
Food processing		
Beer	5.0	Orange juice
Pickle processing	4.0	
		Vinegar
	3.0	
Lemon juice		
	2.0	
	1.0	
Very acidic	0.0	Battery acid

5.2 Required Equipment for pH Testing

- pH meter
- pH 7.0 buffer solution
- Tap water
- Six labeled container and a tray

pH testing equipment

5.3 pH Procedure

1. Check pH meter function prior to sampling time. If your meter does not calibrate during steps 7-12, check the batteries. Change them, if necessary, and attempt calibration again. If the meter still does not calibrate correctly call Kingman Farm at (603)749-1565 for assistance in repairing or replacing the meter.


Immersed pH meter.

2. Immerse the pH probe for at least one hour prior to sampling in enough tap water to cover the probe without going above the black band.

3. pH is temperature dependent so, calibration liquid must be near your sample temperature or vice-versa. Allow the pH 7 buffer to adjust to the same temperature as your sample by leaving it outside for at least one hour.

4. Rinse the “Rinse Sample” and “Test Sample” containers twice with sample water, then fill up to the marked line with water from the sampling bucket.

5. Rinse the “Rinse Tap” and “Test Tap” containers twice with tap water, then fill up to the marked line with tap water.

6. Rinse two containers with pH 7 buffer twice, then fill up to the marked line. The bottle marked “Rinse Buffer pH 7” should contain the older, used buffer and the container marked “Test Buffer pH 7” should contain the new, fresher buffer.

7. Arrange all six small containers in the test kit as per Figure 5.3-1.

In the following steps, place pH probe in enough liquid to cover the electrode without going beyond the black band. This band is a seal to help protect the meter from liquid. It is water resistant, but not water proof. If liquid is allowed to go above this point, it can damage instrument electronics.

8. Remove protector cap from pH probe.

9. Turn the meter on by pressing the “ON/OFF” button.

10. Rinse electrode in containers marked “Rinse Tap” and then in “Test Tap” by stirring gently. There is no need to take pH readings at this point.

11. Rinse probe in bottle of buffer solution marked “Rinse pH 7 Buffer,” then place in “Test pH 7 Buffer.”

12. Press the “CAL” button to enter calibration mode and “CA” will flash in the display window. Stir gently and wait for the displayed value to stabilize.

13. After at least 30 seconds, press “HOLD/CON” to confirm calibration and “CO” will appear in the display window, followed by the calibrated pH. If this number is less than 6.9 or greater than 7.1 repeat steps 9-12. If this does not resolve the error, contact Kingman Farm at (603) 749-1565 for further direction.

14. Rinse the probe in tap water, first the “Rinse Tap” then the “Test Tap.” Do not record any numbers at this point.

15. Rinse probe in the container of “Rinse Sample,” then immerse in “Test Sample” container. Stir once and allow reading to stabilize. The meter will correct for temperature changes.

16. Read pH value in the display window. Record on data sheet.

17. Press “ON/OFF” button to shut off pH meter.

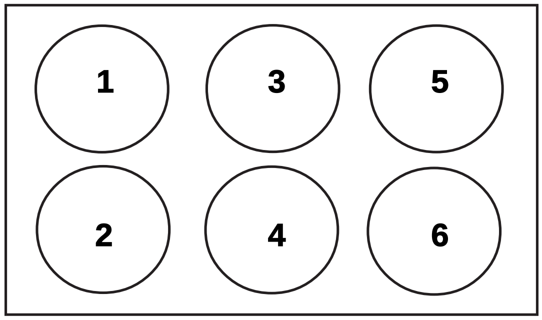
18. Rinse probe again in the “Rinse Tap” then “Test Tap” containers, gently shake off excess water and replace cap.

19. Store meter in toolbox near bottles and in a dry section.

20. At the end of the sampling day, throw out the rinse buffer. Wash and dry the “Rinse Buffer pH 7” bottle and wash the cap. The used “Rinse Buffer pH 7” solution can be disposed of by pouring down the drain if the waste goes to a sewage treatment plant or into waste container.

21. Pour the used “Test pH 7 Buffer” solution into the “Rinse pH 7 Buffer” bottle. Wash “Test pH 7 Buffer” bottle and fill with fresh pH 7 buffer solution from extra buffer solution bottle before next sampling day. Rinse bottles in fresh water and dry thoroughly.

Figure 5.3-1: Diagram of pH Testing Set Up



1 - Rinse Tap Water **3 - Rinse Buffer pH 7** **5 - Rinse Sample Water**
2 - Test Tap Water **4 - Test Buffer pH 7** **6 - Test Sample Water**

Place the pH meter in the containers in the following order:

- 1, 2 clean meter
- 3, 4 calibrate meter
- 1, 2 clean meter
- 5, 6 test pH
- 1, 2 clean meter

6.0 SALINITY

6.1 Salinity Discussion

Salinity is the total amount of all the dissolved solids in the water. The salinity of the open ocean is approximately 35 parts per thousand (ppt), but in the Gulf of Maine, salinity is slightly lower at about 32 or 33 ppt due to river influx. Seven rivers bring fresh water into the Great Bay Estuary, and during the spring run-off, levels of salinity have been recorded as low as 0 parts per thousand (ppt). Salinity may also range as high as 30 ppt. Tolerance of wide-ranging and sometimes rapidly changing salinity determines, more than any other single factor, which species of plants and animals can survive in an estuary. Although salinity levels are higher at the mouth of the Piscataqua River, and generally become progressively lower as we move into the Great Bay proper, winds and tides cause Little Bay and Great Bay to be well-mixed. Mixing also occurs top to bottom, blending the warmer, fresher water that tends to float on top with the cooler, denser salt water brought in by the tides.

Temperature in the Great Bay estuary has a marked pattern of seasonal variation from a winter low of -1.9 °C to as much as 30 °C in the summer. Great Bay is quite shallow, averaging about eight feet, which allows for rapid warming and cooling as the seasons change. From 1973 to 1982, time series analyses of hydrographic trends in the estuary by UNH Professor Ted Loder and others showed that water temperature decreased 0.17 °C per year, while salinity rose 0.34 ppt per year at Dover Point. This trend to colder, saltier water may indicate either local riverflow changes or regional trends affecting the Gulf of Maine.[4]

There are several ways of determining salinity, most of them requiring the use of expensive equipment. However, GBCW volunteers use a hydrometer, an instrument which measures the density of a fluid by making use of Archimedes' Principle. This principle states that "a floating body will displace a volume of water, the mass of which is equal to its own mass." The mass of a hydrometer is fixed so that it floats in pure, distilled water at 1.00 grams per cubic centimeter. The position of the hydrometer in the water column is directly related to the salinity of the water. Salinity is also related to temperature of the water, which we measure. Then we use conversion tables to relate the density and temperature measurements, and extrapolate our salinity reading in parts per thousand.

6.2 Required Equipment for Salinity Testing

- Armored thermometer
- Hydrometer
- Hydrometer jar (500 mL cylinder)
- Hydrometer case with cork stopper

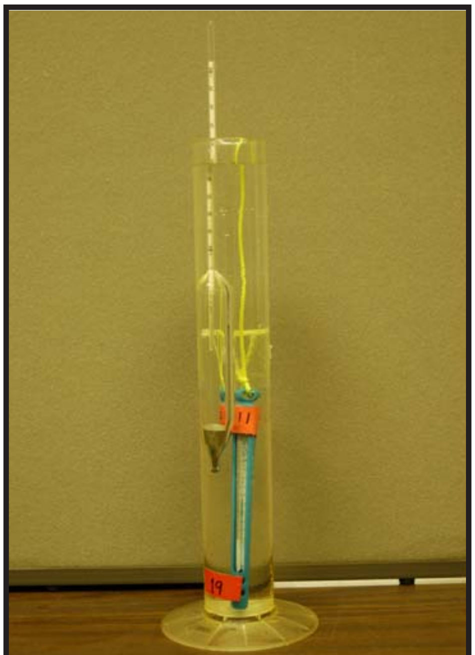
Salinity testing equipment.

6.3 Salinity Procedure

1. Using water from the sampling bucket, fill the 500 mL cylinder to approximately one inch below the rim.

2. Hang the armored thermometer in the cylinder.

3. Gently insert the hydrometer with a twisting motion. This removes any air bubbles. Be sure not to drop the hydrometer into the jar as this could cause it to hit the bottom of the cylinder too hard and break.



Thermometer in cylinder with hydrometer.

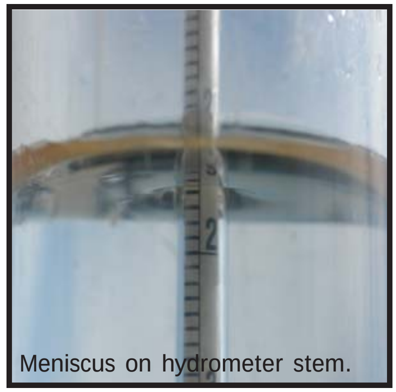
> The water temperature measured in the sampling bucket is not sufficient for this test. The temperature of the water in the cylinder must be measured immediately prior to reading the hydrometer as temperature can change once it is in the cylinder.

4. Level the cylinder so hydrometer is vertical and not touching the sides. Try to keep it out of the wind.

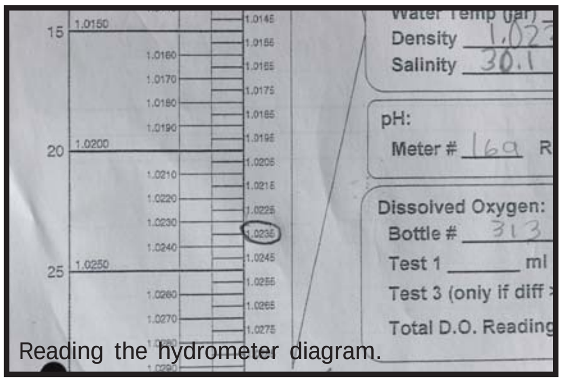
5. After 3 minutes, read the thermometer to the nearest 0.5 °C and record on data sheet. When taking reading, make sure the bottom of the thermometer remains in the water.

6. Remove the thermometer.

7. Read the density using the scale on the hydrometer, taking care to read at the bottom of the curve formed where the water rises slightly as it touches the sides of the hydrometer. (A magnifying glass may be helpful.) This curve is called the meniscus.



Meniscus on hydrometer stem.



Reading the hydrometer diagram.

8. On your data sheet, show where the meniscus is by marking the “READING THE HYDROMETER” diagram. Record the density reading on your field data sheet.

9. To determine the salinity, use Table 6-1, the five-page salinity table (see the following pages). Locate the density in the left hand column and the recorded temperature across the top of the appropriate page. Then, read down to the appropriate salinity and record the result on your field data sheet.

   If you find the density or temperature reading to be a value ending in five (5), you will need to interpolate the result on the table. This is done by taking the average of the points above and below the value. For example, if the density reading from the hydrometer is 1.0135, you would take the values for 1.0140 and 1.0130 and average them to get the salinity value.

10. Record the number of your hydrometer on the data sheet. It is found near the neck on white paper inside the stem.

TABLE 6.3-1: **Salinity** (Temperatures 1.0 - 8.0 °C)

Table 1. Salinity in parts per thousand (ppt)

NOTE: This table is designed for use with 60°/60°F hydrometer.

Observed	Temperature of Water in Graduated Cylinder (°C)									
Reading	-1.0	0.0	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0
1.0000										
1.0010	0.6	0.6	0.5	0.5	0.2	0.2	0.2	0.2	0.2	0.2
1.0020	1.9	1.9	1.8	1.6	1.6	1.6	1.5	1.5	1.6	1.6
1.0030	3.2	3.1	2.9	2.9	2.8	2.8	2.8	2.8	2.8	2.9
1.0040	4.4	4.2	4.2	4.1	4.1	4.1	4.1	4.1	4.1	4.2
1.0050	5.7	5.5	5.4	5.4	5.4	5.3	5.3	5.4	5.4	5.4
1.0060	6.8	6.8	6.7	6.6	6.6	6.6	6.6	6.6	6.7	6.7
1.0070	8.1	8.0	7.9	7.9	7.9	7.9	7.9	7.9	7.9	8.0
1.0080	9.3	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.3
1.0090	10.5	10.5	10.4	10.4	10.4	10.4	10.4	10.5	10.5	10.6
1.0100	11.8	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.8	11.8
1.0110	13.0	13.0	12.8	12.8	12.8	12.8	13.0	13.0	13.1	13.1
1.0120	14.3	14.1	14.1	14.1	14.1	14.1	14.1	14.3	14.3	14.4
1.0130	15.4	15.4	15.4	15.4	15.4	15.4	15.4	15.4	15.6	15.7
1.0140	16.7	16.6	16.6	16.6	16.6	16.6	16.7	16.7	16.9	17.0
1.0150	17.9	17.9	17.9	17.9	17.9	17.9	17.9	18.0	18.0	18.2
1.0160	19.2	19.1	19.1	19.1	19.1	19.2	19.2	19.3	19.3	19.5
1.0170	20.4	20.4	20.4	20.4	20.4	20.4	20.5	20.5	20.6	20.8
1.0180	21.7	21.7	21.6	21.6	21.7	21.7	21.7	21.8	22.0	22.1
1.0190	22.9	22.9	22.9	22.9	22.9	23.0	23.0	23.1	23.3	23.4
1.0200	24.2	24.2	24.0	24.2	24.2	24.2	24.3	24.3	24.4	24.6
1.0210	25.3	25.3	25.3	25.3	25.5	25.5	25.6	25.6	25.7	25.9
1.0220	26.6	26.6	26.6	26.6	26.6	26.8	26.8	26.9	27.0	27.2
1.0230	27.8	27.8	27.8	27.8	27.9	27.9	28.1	28.2	28.3	28.5
1.0240	29.1	29.1	29.1	29.1	29.1	29.2	29.4	29.5	29.5	29.8
1.0250	30.3	30.3	30.3	30.4	30.4	30.6	30.6	30.7	30.8	30.9
1.0260	31.6	31.6	31.6	31.6	31.7	31.7	31.9	32.0	32.1	32.2
1.0270	32.8	32.8	32.9	32.9	32.9	33.0	33.2	33.3	33.4	33.5
1.0280	34.1	34.1	34.1	34.1	34.2	34.3	34.5	34.5	34.7	34.8
1.0290	35.2	35.2	35.4	35.4	35.5	35.5	35.6	35.8	35.9	36.2
1.0300	36.5	36.5	36.5	36.7	36.7	36.8	36.9	37.1	37.2	37.3
1.0310	37.7	37.7	37.8	37.8	38.0	38.1	38.2	38.4	38.5	38.6

TABLE 6.3-1: **Salinity** (Temperatures 9.0 - 18.0 °C)

Table 1. Salinity in parts per thousand (ppt)

NOTE: This table is designed for use with 60°/60°F hydrometer.

Observed Reading	Temperature of Water in Graduated Cylinder (°C)									
	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16.0	17.0	18.0
1.0000								0.0	0.2	0.3
1.0010	0.5	0.5	0.6	0.6	0.7	0.8	1.0	1.2	1.5	1.6
1.0020	1.6	1.8	1.9	2.0	2.1	2.3	2.4	2.5	2.8	2.9
1.0030	2.9	3.1	3.2	3.3	3.4	3.6	3.7	3.8	4.1	4.2
1.0040	4.2	4.4	4.5	4.6	4.8	4.9	5.0	5.1	5.4	5.5
1.0050	5.5	5.5	5.7	5.8	5.9	6.2	6.3	6.6	6.7	7.0
1.0060	6.8	6.8	7.0	7.1	7.2	7.5	7.6	7.9	8.0	8.3
1.0070	8.1	8.1	8.3	8.4	8.5	8.8	8.9	9.2	9.3	9.6
1.0080	9.3	9.4	9.6	9.7	9.8	10.0	10.2	10.5	10.6	10.9
1.0090	10.6	10.7	10.9	11.0	11.1	11.3	11.5	11.8	11.9	12.2
1.0100	11.9	12.0	12.2	12.3	12.4	12.6	12.8	13.1	13.2	13.5
1.0110	13.2	13.4	13.5	13.6	13.7	13.9	14.1	14.4	14.5	14.8
1.0120	14.5	14.7	14.8	14.9	15.0	15.2	15.4	15.7	15.8	16.1
1.0130	15.8	15.8	16.0	16.2	16.3	16.5	16.7	17.0	17.1	17.4
1.0140	17.0	17.1	17.3	17.5	17.7	17.8	18.0	18.3	18.6	18.7
1.0150	18.3	18.4	18.6	18.8	19.0	19.1	19.3	19.6	19.9	20.0
1.0160	19.6	19.7	19.9	20.1	20.3	20.4	20.6	20.9	21.2	21.3
1.0170	20.9	21.0	21.2	21.3	21.6	21.7	22.0	22.2	22.5	22.7
1.0180	22.2	22.3	22.5	22.6	22.9	23.0	23.3	23.5	23.8	24.0
1.0190	23.5	23.6	23.8	23.9	24.2	24.3	24.6	24.8	25.1	25.3
1.0200	24.7	24.8	25.1	25.2	25.5	25.6	25.9	26.1	26.4	26.6
1.0210	26.0	26.1	26.4	26.5	26.8	26.9	27.2	27.4	27.7	27.9
1.0220	27.3	27.4	27.7	27.8	28.1	28.2	28.5	28.7	29.0	29.2
1.0230	28.6	28.7	28.9	29.1	29.4	29.5	29.8	30.0	30.3	30.6
1.0240	29.9	30.0	30.2	30.4	30.6	30.8	31.1	31.3	31.6	31.9
1.0250	31.1	31.3	31.5	31.7	31.9	32.1	32.4	32.6	32.9	33.2
1.0260	32.4	32.6	32.8	33.0	33.2	33.4	33.7	33.9	34.2	34.5
1.0270	33.7	33.9	34.1	34.3	34.5	34.7	35.0	35.2	35.5	35.8
1.0280	35.0	35.1	35.4	35.6	35.8	36.0	36.3	36.5	36.8	37.1
1.0290	36.3	36.4	36.7	36.8	37.1	37.3	37.6	37.8	38.1	38.4
1.0300	37.6	37.7	38.0	38.1	38.4	38.6	38.9	39.1	39.4	39.7
1.0310	38.9	39.0	39.3	39.4	39.7	39.9	40.2	40.5	40.7	41.0

TABLE 6.3-1: Salinity (Temperatures 18.5 - 23.0 °C)

Table 1. Salinity in parts per thousand (ppt)

NOTE: This table is designed for use with 60°/60°F hydrometer.

Observed	Temperature of Water in Graduated Cylinder (°C)									
Reading	18.5	19.0	19.5	20.0	20.5	21.0	21.5	22.0	22.5	23.0
0.9990							0.0	0.1	0.2	0.3
1.0000	0.5	0.6	0.7	0.8	1.0	1.1	1.2	1.4	1.5	1.6
1.0010	1.8	1.9	2.0	2.1	2.3	2.4	2.5	2.5	2.7	2.8
1.0020	3.1	3.2	3.3	3.4	3.6	3.7	3.8	4.0	4.1	4.2
1.0030	4.4	4.5	4.6	4.8	4.9	5.0	5.1	5.3	5.4	5.5
1.0040	5.7	5.8	5.9	6.1	6.2	6.3	6.4	6.6	6.7	7.0
1.0050	7.1	7.1	7.2	7.4	7.5	7.6	7.7	7.9	8.1	8.3
1.0060	8.4	8.5	8.7	8.8	8.9	9.1	9.2	9.3	9.4	9.6
1.0070	9.7	9.8	10.0	10.1	10.2	10.4	10.5	10.6	10.7	10.9
1.0080	11.0	11.1	11.3	11.4	11.5	11.7	11.8	11.9	12.0	12.2
1.0090	12.3	12.4	12.6	12.7	12.8	13.0	13.1	13.2	13.4	13.6
1.0100	13.6	13.7	13.9	14.0	14.1	14.3	14.4	14.5	14.8	14.9
1.0110	14.9	15.0	15.2	15.3	15.4	15.6	15.7	16.0	16.1	16.2
1.0120	16.2	16.3	16.5	16.6	16.7	17.0	17.1	17.3	17.4	17.5
1.0130	17.5	17.7	17.8	17.9	18.0	18.3	18.4	18.6	18.7	18.8
1.0140	18.8	19.0	19.1	19.3	19.5	19.6	19.7	19.9	20.0	20.1
1.0150	20.1	20.4	20.5	20.6	20.8	20.9	21.0	21.2	21.3	21.6
1.0160	21.4	21.7	21.8	22.0	22.1	22.2	22.3	22.5	22.7	22.9
1.0170	22.9	23.0	23.1	23.3	23.4	23.5	23.6	23.8	24.0	24.2
1.0180	24.2	24.3	24.4	24.6	24.7	24.8	24.9	25.2	25.3	25.5
1.0190	25.5	25.6	25.7	25.9	26.0	26.1	26.4	26.5	26.6	26.8
1.0200	26.8	26.9	27.0	27.2	27.3	27.4	27.7	27.8	27.9	28.2
1.0210	28.1	28.2	28.3	28.5	28.6	28.9	29.0	29.1	29.2	29.5
1.0220	29.4	29.5	29.6	29.8	30.0	30.2	30.3	30.4	30.7	30.8
1.0230	30.7	30.8	30.9	31.2	31.3	31.5	31.6	31.7	32.0	32.1
1.0240	32.0	32.1	32.2	32.5	32.6	32.8	32.9	33.2	33.3	33.4
1.0250	33.3	33.4	33.7	33.8	33.9	34.1	34.2	34.5	34.6	34.7
1.0260	34.6	34.7	35.0	35.1	35.2	35.4	35.6	35.8	35.9	36.0
1.0270	35.9	36.2	36.3	36.4	36.5	36.7	36.9	37.1	37.2	37.5
1.0280	37.2	37.5	37.6	37.7	37.8	38.1	38.2	38.4	38.5	38.8
1.0290	38.6	38.8	38.9	39.0	39.1	39.4	39.5	39.7	39.9	40.1
1.0300	39.9	40.1	40.2	40.3	40.6	40.7	40.8	41.0	41.2	41.4
1.0310	41.2	41.4	41.5	41.8	41.9	42.0	42.1	42.3	42.5	

TABLE 6.3-1: **Salinity** (Temperatures 23.5 - 28 °C)

Table 1. Salinity in parts per thousand (ppt)

NOTE: This table is designed for use with 60°/60°F hydrometer.

Observed Reading	Temperature of Water in Graduated Cylinder (°C)									
	23.5	24.0	24.5	25.0	25.5	26.0	26.5	27.0	27.5	28.0
0.9980							0.1	0.2	0.3	0.6
0.9990	0.5	0.6	0.7	0.8	1.0	1.2	1.4	1.5	1.8	1.9
1.0000	1.8	1.9	2.0	2.1	2.4	2.5	2.7	2.9	3.1	3.2
1.0010	2.9	3.1	3.2	3.4	3.6	3.8	4.0	4.2	4.4	4.5
1.0020	4.4	4.6	4.8	4.9	5.0	5.1	5.4	5.5	5.7	5.9
1.0030	5.8	5.9	6.1	6.2	6.3	6.6	6.7	6.8	7.1	7.2
1.0040	7.1	7.2	7.4	7.5	7.7	7.9	8.0	8.3	8.4	8.5
1.0050	8.4	8.5	8.7	8.9	9.1	9.2	9.3	9.6	9.7	10.0
1.0060	9.7	9.8	10.1	10.2	10.4	10.5	10.7	10.9	11.0	11.3
1.0070	11.0	11.3	11.4	11.5	11.7	11.9	12.0	12.2	12.4	12.6
1.0080	12.4	12.6	12.7	12.8	13.0	13.2	13.4	13.6	13.7	13.9
1.0090	13.7	13.9	14.0	14.1	14.4	14.5	14.7	14.9	15.0	15.3
1.0100	15.0	15.2	15.3	15.6	15.7	15.8	16.1	16.2	16.5	16.6
1.0110	16.3	16.5	16.7	16.9	17.0	17.3	17.4	17.5	17.8	17.9
1.0120	17.7	17.9	18.0	18.2	18.3	18.6	18.7	19.0	19.1	19.3
1.0130	19.1	19.2	19.3	19.5	19.7	19.9	20.0	20.3	20.4	20.6
1.0140	20.4	20.5	20.6	20.9	21.0	21.2	21.4	21.6	21.8	22.0
1.0150	21.7	21.8	22.0	22.2	22.3	22.5	22.7	22.9	23.1	23.3
1.0160	23.0	23.3	23.4	23.5	23.6	23.9	24.0	24.3	24.4	24.7
1.0170	24.3	24.6	24.7	24.8	25.1	25.2	25.3	25.6	25.7	26.0
1.0180	25.6	25.9	26.0	26.1	26.4	26.5	26.8	26.9	27.2	27.3
1.0190	27.0	27.2	27.3	27.6	27.7	27.8	28.1	28.2	28.5	28.6
1.0200	28.3	28.5	28.6	28.9	29.0	29.2	29.4	29.6	29.8	30.0
1.0210	29.6	29.8	30.0	30.2	30.3	30.6	30.7	30.9	31.1	31.3
1.0220	30.9	31.2	31.3	31.5	31.7	31.9	32.0	32.2	32.5	32.6
1.0230	32.2	32.5	32.6	32.8	33.0	33.2	33.4	33.5	33.8	33.9
1.0240	33.7	33.8	33.9	34.2	34.3	34.5	34.7	35.0	35.1	35.4
1.0250	35.0	35.1	35.2	35.5	35.6	35.9	36.0	36.3	36.4	36.7
1.0260	36.3	36.4	36.7	36.8	36.9	37.2	37.3	37.6	37.7	38.0
1.0270	37.6	37.8	38.0	38.1	38.4	38.5	38.8	38.9	39.1	39.3
1.0280	38.9	39.1	39.3	39.4	39.7	39.8	40.1	40.2	40.5	40.7
1.0290	40.2	40.5	40.6	40.8	41.0	41.2	41.4	41.6	41.8	
1.0300	41.6	41.8	41.9							
1.0310										

TABLE 6.3-1: **Salinity** (Temperatures 28.5 - 33.0 °C)

Table 1. Salinity in parts per thousand (ppt)

NOTE: This table is designed for use with 60°/60°F hydrometer.

Observed	Temperature of Water in Graduated Cylinder (°C)									
Reading	28.5	29.0	29.5	30.0	30.5	31.0	31.5	32.0	32.5	33.0
0.9980	0.7	0.8	1.1	1.2	1.5	1.6	1.9	2.0	2.3	2.4
0.9990	2.0	2.3	2.4	2.5	2.8	2.9	3.2	3.4	3.6	3.8
1.0000	3.4	3.6	3.7	4.0	4.1	4.4	4.5	4.8	4.9	5.1
1.0010	4.8	4.9	5.1	5.1	5.4	5.5	5.8	5.9	6.2	6.4
1.0020	6.1	6.3	6.4	6.6	6.8	7.0	7.2	7.5	7.6	7.9
1.0030	7.4	7.6	7.7	8.0	8.1	8.4	8.5	8.8	9.1	9.2
1.0040	8.8	8.9	9.2	9.3	9.6	9.7	10.0	10.1	10.4	10.5
1.0050	10.1	10.2	10.5	10.6	10.9	11.0	11.3	11.5	11.7	11.9
1.0060	11.4	11.7	11.8	12.0	12.2	12.4	12.6	12.8	13.1	13.2
1.0070	12.8	13.0	13.1	13.4	13.6	13.7	14.0	14.1	14.4	14.7
1.0080	14.1	14.3	14.5	14.7	14.9	15.2	15.3	15.6	15.7	16.0
1.0090	15.4	15.7	15.8	16.1	16.2	16.5	16.6	16.9	17.1	17.3
1.0100	16.7	17.0	17.1	17.4	17.5	17.8	18.0	18.2	18.4	18.7
1.0110	18.2	18.3	18.6	18.7	19.0	19.1	19.3	19.6	19.7	20.0
1.0120	19.5	19.6	19.9	20.1	20.3	20.5	20.6	20.9	21.2	21.3
1.0130	20.8	21.0	21.2	21.4	21.6	21.8	22.1	22.2	22.5	22.7
1.0140	22.2	22.3	22.6	22.7	23.0	23.1	23.4	23.6	23.8	24.0
1.0150	23.5	23.6	23.9	24.0	24.3	24.6	24.7	24.9	25.2	25.3
1.0160	24.8	25.1	25.2	25.5	25.6	25.9	26.1	26.3	26.5	26.8
1.0170	26.1	26.4	26.5	26.8	27.0	27.2	27.4	27.7	27.8	28.1
1.0180	27.6	27.7	27.9	28.1	28.3	28.5	28.7	29.0	29.2	29.4
1.0190	28.9	29.0	29.2	29.5	29.6	29.9	30.0	30.3	30.6	30.8
1.0200	30.2	30.4	30.6	30.8	30.9	31.2	31.5	31.6	31.9	32.1
1.0210	31.5	31.7	32.0	32.1	32.4	32.5	32.8	33.0	33.3	33.4
1.0220	32.9	33.0	33.3	33.4	33.7	33.9	34.1	34.3	34.6	34.8
1.0230	34.2	34.5	34.6	34.8	35.0	35.2	35.5	35.6	35.9	36.2
1.0240	35.5	35.8	35.9	36.2	36.4	36.5	36.8	37.1	37.2	37.5
1.0250	36.8	37.1	37.2	37.5	37.7	37.8	38.1	38.4	38.6	38.8
1.0260	38.2	38.4	38.6	38.8	39.0	39.3	39.4	39.7	39.9	40.2
1.0270	39.5	39.8	39.9	40.2	40.3	40.6	40.8	41.0	41.2	41.5
1.0280	40.8	41.1	41.2	41.5						

7.0 DISSOLVED OXYGEN

7.1 Dissolved Oxygen Discussion

Dissolved oxygen (DO) is one of the most important indicators of the quality of water for aquatic life. It is essential for all plants and animals inhabiting Great Bay. When oxygen levels in the water fall below about 3-5 parts per million (ppm), fish and many other aquatic organisms cannot survive. Oxygen is a particularly sensitive constituent because chemicals present in the water, biological processes, and temperature greatly influence on its availability during the year.

A DO test (using kit or meter) measures how much oxygen is dissolved in the water, but it does not tell you how much dissolved oxygen the water can hold at the tested temperature. When water holds the maximum DO at a given temperature, it is said to be 100 percent saturated with oxygen. The warmer the water is, the less DO it can hold and the colder the water, the more DO it can hold. Table 7.1-1 shows this relationship at various temperatures.

Oxygen is transferred from the atmosphere into the surface waters by the aerating action of the wind. It is also added at or near the surface as a byproduct of plant photosynthesis. As a result, floating and rooted aquatic plants increase DO levels. Since the existence of plants also depends on the availability of light, the oxygen-producing processes occur only near the surface or in shallow waters. Oxygen levels may be reduced because the water is too warm (e.g., near a power plant) or because there are too many bacteria or aquatic organisms in the area. When algae growth is excessive, as in a “bloom,” the upper levels of algae can shade the light from lower levels, causing fish kills, death of other organisms, or unpleasant odors. At night, photosynthesis stops and the algae respire (i.e., breathe). This can use up available oxygen and the algae may suffocate, die, and decay.

While the overall oxygen content in the water is important in assessing the health of a water body, it is also useful to look at DO in terms of “percent saturation.” Percent saturation is the ratio of oxygen concentration that is in the water compared to the oxygen concentration that could *be* in the water at a given temperature and salinity. One might expect that the highest obtainable percent saturation value to be 100 percent. However, “supersaturation” (i.e., values greater than 100 percent) can occur under certain conditions. Very high concentrations of oxygen are possible in areas with a great deal of aquatic vegetation (i.e., oxygen production through photosynthesis) or in areas with strong wind and wave action (i.e., addition of oxygen through “entrainment” of atmospheric oxygen into the water).

Table 7.1-1: Solubility of Dissolved Oxygen in Fresh Water (at 100% Saturation)

Temperature (^0C)	Solubility (ppm or mg/L)	Temperature (^0C)	Solubility (ppm or mg/L)
0	14.6	16	10.0
1	14.2	17	9.8
2	13.8	18	9.6
3	13.5	19	9.4
4	13.1	20	9.2
5	12.8	21	9.0
6	12.5	22	8.9
7	12.2	23	8.7
8	11.9	24	8.6
9	11.6	25	8.4
10	11.3	26	8.2
11	11.1	27	8.1
12	10.9	28	7.9
13	10.6	29	7.8
14	10.4	30	7.7
15	10.2		

As shown above in Table 7.1-1, the amount of dissolved oxygen which can be held at various temperatures varies greatly. It depends not only upon temperature, but on conditions such as photosynthesis, wind, light, algae blooms, etc. Very low readings (under 4 ppm) should be rechecked. Very high readings above those in Table 7.1-1 at a given temperature may indicate supersaturated levels of dissolved oxygen. These should also be rechecked. If confirmed by a second reading, such supersaturated levels may be indicated by high wind or very sunny conditions, combined with large amounts of live plant material.

7.2 Required Equipment for Dissolved Oxygen (DO) Testing

- 2 graduated burettes
- 2 glass rods
- 2 glass marbles
- 2 glass Wheaton DO/BOD bottles with stoppers
- 1 100 mL graduated cylinder
- 1 box manganese sulfate pillows (Pillow #1)
- 1 box iodide-azide pillows (Pillow #2)
- 1 bag of sulfamic acid pillows (Pillow #3)
- 1 pair scissors or clippers
- 1 dropper bottle starch solution
- 1 bottle sodium thiosulfate
- 1 plastic beaker

DO testing equipment.

7.3 Dissolved Oxygen Procedure


Water overflowing to fill BOD bottle.

1. Release clamp on the sampling bucket tube, empty the tubing of bubbles, and insert flow tube from sample bucket into bottle, all the way to the bottom of bottle.

Tube inserted into BOD bottle.

2. Keep track of the amount of time it takes to fill the bottle to the point of overflow (counting as it fills will be fine), and allow enough time for the bottle to have filled three times. Remove the flow tube from the BOD slowly before stopping the flow of water. This ensures the BOD is full to the brim.

3. Examine sample to make sure no bubbles are trapped inside. Don't splash water out. Repeat step 2 until there are no bubbles. Temporarily replace glass stopper if carrying sample away from water's edge to do the procedure. Once a satisfactory sample has been collected, proceed to steps 4, 5 and 6.

> Be careful not to introduce air into the sample while adding the reagents in steps 4 and 5 below.


Settled precipitate in BOD bottle.

4. Cut open the manganese sulfate powder (pillow #1) and add to sample.

5. Cut open the alkaline iodide-azide powder (pillow #2) and add to sample.

6. Carefully add a small marble to the bottle before replacing the stopper. Replace stopper, twist 1/4 turn to get a good seal. Place finger on top to hold it on bottle. Invert bottle gently several times to mix reagents with water. A precipitate will form. Place sample aside and allow precipitate to settle to bottom half of bottle. Gently invert bottle to mix and allow settling again.

Addition of the marble in step 6 has two benefits. It tops off the level of the liquid in the bottle and eliminates the air bubble that sometimes forms between the liquid and the stopper. Second, the marble helps to mix the powered reagents when the bottle is swirled. The marble should be clean and should be added gently to prevent the possibility of introducing air into the bottle.

After finishing step 6, go on to your other tests while the sampling is settling. Now that step 6 is complete, contact between the water sample and the atmosphere will not affect the test result. Once the sample has been “fixed” in this manner, it is not necessary to perform the actual test procedure immediately. Thus, several samples can be collected and “fixed” in the field and then carried back to a testing station or laboratory where the titration procedure is to be performed. Make certain samples are kept cool if titrating later. However, the test must be completed within one hour.

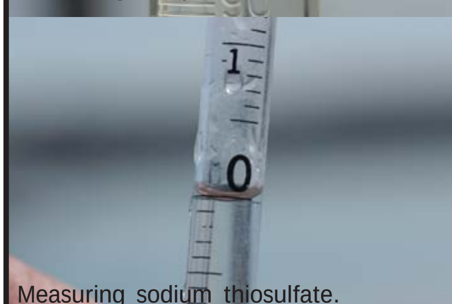
7. Cut open the sulfamic acid (pillow #3) and add to sample. Replace stopper and invert gently several times and swirl to mix until precipitate and powdered reagents have dissolved. All of the powder must be dissolved before you go on. A clear yellow to brown-orange color will develop, depending on the oxygen content of the sample.

8. Pour 100 mL of the sample carefully into a clean 100 mL graduated cylinder. Tilt the cylinder and pour the sample carefully down the inside wall to avoid mixing bubbles into the sample. Then pour the sample from the cylinder into the test beaker, again carefully pouring down the inside of the beaker. The bubbles will not add dissolved oxygen to the water at this point, but can displace the water and give you an incorrect measurement. Tap the cylinder to remove the bubbles and make sure the meniscus is at 100 mL.

9. Fill burette to above the zero mark with sodium thiosulfate titrant and clear bubbles out of burette. Tap the burette to get rid of bubbles above the bead valve. Point the tip up over your waste container and tap or squeeze the bead valve to remove the bubbles below the bead valve. Make sure liquid fills burette from tip to the zero mark. Refill to zero mark if necessary.


Pouring sample.

Measuring sample.



Measuring sodium thiosulfate.

10. Slowly add sodium thiosulfate titrant to test beaker containing the 100 mL of sample, stirring as titrant is added. Stop titrating when amber colored solution in beaker begins to lighten to a light hay color. Place white paper under beaker to watch for test color change in step 12.

Amber color

Hay color

11. Add 8 drops of starch solution to beaker. Sample will turn a dark blue color.

12. Continue the titration process with the sodium thiosulfate remaining in the burette until test sample turns colorless. Do not add any more titrant than is necessary to produce the color change. Be sure to stir sample as each drop is added.

13. Using the scale on the side of the burette, count the total number of mL of sodium thiosulfate used in the titration. Enter this number in the space provided on your data sheet.

14. Rinse out the beaker and repeat steps 8 through 13 on a second 100 mL of the water sample.

15. Record results of the second titration in the space provided on data sheets.

16. Add the results of the 2 titrations (mL = mg/L) and enter the value on your data sheet.

These duplicate titrations are run to guard against analysis errors. If the DO result in the second titration is equal to or greater than 0.3 mL different than the first titration, a third titration needs to be performed. If less than 100 mL of the sample remains for the third titration, use 50 mL and double the result. Record all three results. However, only add the 2 results that are within 0.3 mL difference.

17. Once the DO testing has been completed, rinse BOD bottles thoroughly. Also, make sure glass marbles are cleaned and stored to prevent loss.

8.0 FECAL COLIFORM **BACTERIA**

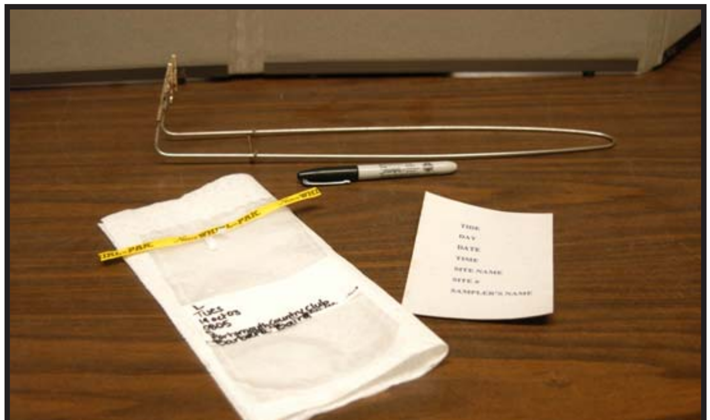
8.1 Fecal coliform **Bacteria Discussion**

Fecal coliform bacteria in the water are used as an indicator of human sewage pollution. While fecal coliform bacteria are found in the feces of all warm-blooded animals, their presence in the water can indicate that other, more dangerous bacteria are present. Their presence in high numbers can also indicate pollution from improperly treated sewage effluent, waste discharges from boats, improperly functioning or failed septic systems, untreated urban storm water, runoff from agricultural operations, feces from wildlife, or other sources. New Hampshire water quality standards for tidal waters use another kind of bacteria (i.e., *Enterococci*) to determine if waters are safe for swimming. State standards for tidal shellfish waters, however, do specify acceptable levels of fecal coliforms. While direct application of shellfish water standards to GBCW data would not be appropriate, these standards can be used to give a general sense of contamination in the estuary. Fecal coliform bacteria tests are performed using the membrane filtration (plate count) method.

Photo: Bill Macklin demonstrates use of the Whirlpak bag.

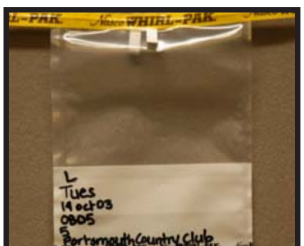
8.2 Required Equipment/Sample Collection for Fecal Coliform Bacteria Testing

- Sampling bags
- Marking pen
- Sampling tongs
- Cold packs and a cooler



Equipment used to collect water sample for *Fecal coliform* bacteria testing.

8.3 Fecal Coliform Sample Collection Procedure



Properly labeled bag.

1. Label bag in the white area with a medium tip permanent marker:

    - Sample Site Number
    - SiteName
    - Date
    - Day
    - Time of Sample
    - Tidal Stage (Low or High)
    - Sampler's Name.

2. Attach the alligator clips of the tongs to the metal tabs of the sterile sampling bag. Curl tab over and pinch clips to secure bag to the tongs. The use of gloves here is optional. Finally, tug bottom of bag to make certain the bag is securely held.

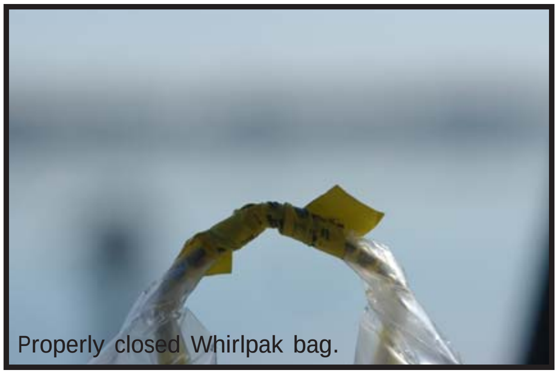
3. Remove perforation strip from the top of the bag. Check again that the bag is secure on the clips.

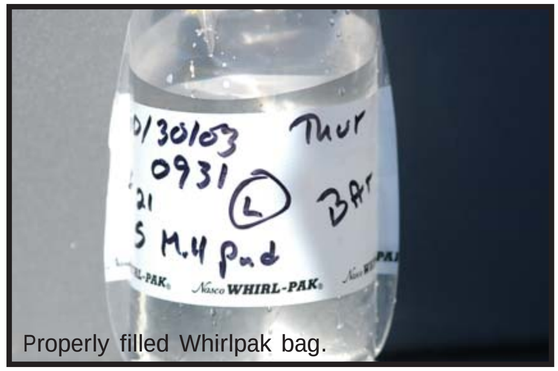
> Do not touch the bag opening with fingers or gloves as this will contaminate the sample. Also do not touch the mouth or inside of the bag!

4. With the bag still closed, plunge the bag into the water to a depth of about 12 inches.

5. Open the bag by squeezing the tongs together and fill the bag. Close the bag when returning to the surface by releasing the pressure on the tongs.

6. Immediately remove the filled bag from the water. Use one hand to support the bottom of the bag, to ease the weight off the tabs. The bag needs to be about 2/3 full. Pinch the bottom of the bag to spill excess water over the top of the bag. Air space over the surface of the water is required to keep any bacteria present alive until the sample is processed.
7. Spin the bag over itself several times to close the bag securely, so that water will not leak out. Wearing protective glasses during this step is recommended.


Properly closed Whirlpak bag.



Properly filled Whirlpak bag.

8. Remove the clips and twist the metal tabs together in the shape a bracelet, curling the ends in. This prevents the sharp ends from puncturing other samples when the bag is stored at the lab.

9. Keep the samples in a cooler with a cold pack. Bring samples to Kingman Farm before 6:00 p.m. on the day of sampling.

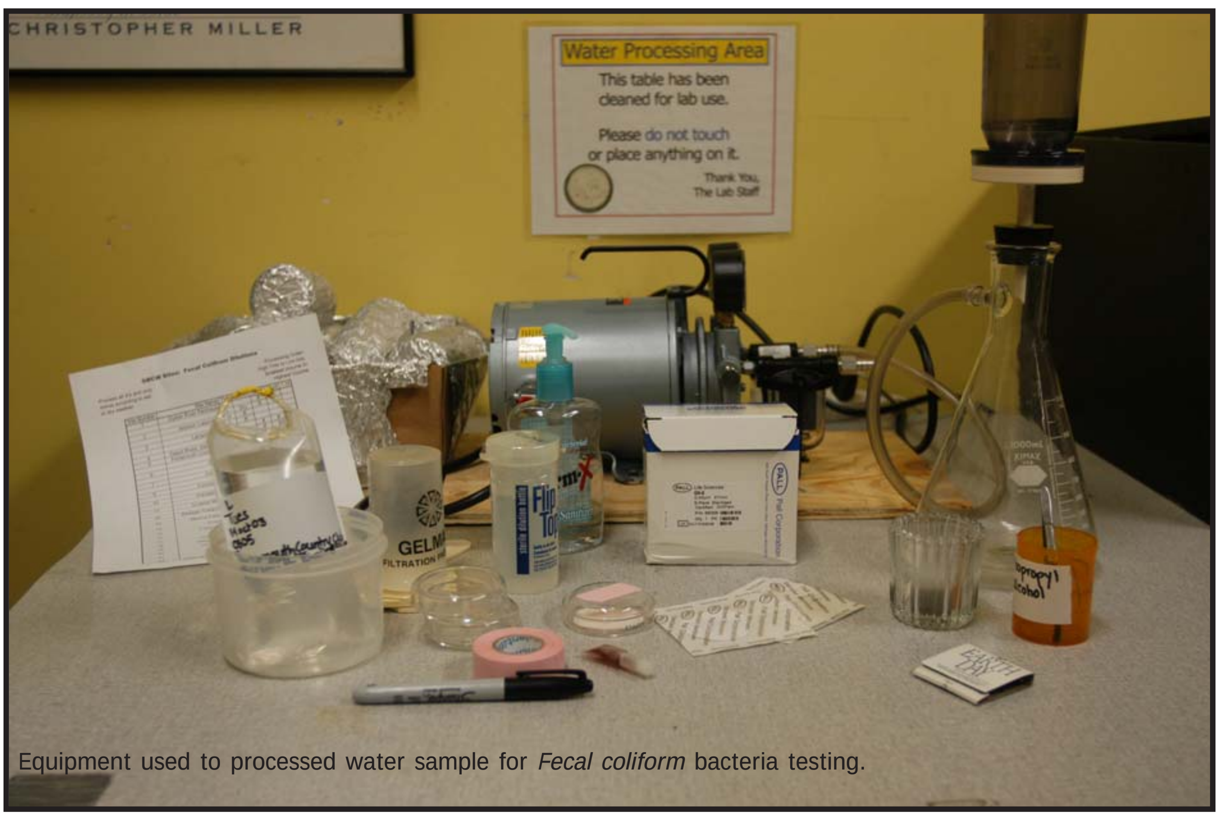
> If you need the sample picked up, please call Kingman Farm at (603)749-1565 to make arrangements.

10. The samples may be refrigerated below 10 °C and stored for up to six hours.

11. To review this procedure you may borrow the Processing Fecal Coliform Bacteria video.

8.4 Required Equipment / Sample Processing for Fecal Coliform BacteriaTesting

- Sterile Petri dishes
- Coliform record sheet
- Spray disinfectant
- Water bath incubator
- Distilled water
- Filtration flask
- Filter base with stopper
- Aluminum foil
- Labeling tape
- Alcohol
- Phosphate buffer
- Absorbent filter pads
- Membrane filters
- Ampules of growth medium (MB Broth)
- Sterile pipettes (10 mL and 1 mL)
- Automatic pipette
- Oil lamp or candle
- Tissues
- UV sterilizer
- Filter funnel
- Filter forceps
- Autoclave tape
- Vacuum pump or hand pump



Equipment used to processed water sample for *Fecal coliform* bacteria testing.

8.5 Preparation for Sample Processing for Fecal Coliform Bacteria Testing

1. Fill incubator and check that the temperature is set to 44.5 °C. Incubator temperature may fluctuate ± 0.2 °C.

2. Record the label information on the fecal coliform bacteria record sheet.

3. Make sure that all of filtration equipment is sterilized. The UV bulb should be cleaned with ethanol at least once a month. Sterilize all filtration equipment for at least ten minutes using the UV light box. The filtration apparatus should be placed in the UV light box with the inside of the funnel facing towards the bulb. Place the filter funnel base into the flask.

4. Check that a sufficient number of Petri dishes have been sterilized in an autoclave or other steam sterilizer device. To sterilize, place the support stand in the bottom of the sterilizer and pour in two inches of tap water. Wrap all the Petri dishes to be sterilized in aluminum foil, place a piece of autoclave tape around it, and place into the autoclave bucket. Place the bucket in the sterilizer with the exhaust channel on the right hand side. Make sure there is a thin layer of petroleum jelly along the beveled edge of the lid. This will help provide a tight seal on the sterilizer. The petroleum jelly should be applied every three to four times the sterilizer is used. Place the lid on the sterilizer by feeding the steam exhaust tube into the exhaust channel of the bucket. Twist the lid so that the engraved marks on the lid and the sterilizer meet. Tighten the lock nuts, two at a time (opposite from each other), to make a tight seal. Put the exhaust valve in open or vertical position. Turn the power switch on.

   Once stream begins to escape from the exhaust valve (after about 20 minutes), it is necessary to wait five minutes to allow the “cold zones” to be flushed out of the sterilizer. Close the exhaust valve by putting it in the horizontal position. When the pressure gauge reads 17 psi, it is sterilizing. It must sterilize at 17 psi for at least 35 minutes to completely sterilize the items. After the time is up, turn the sterilizer off. Release the pressure by carefully opening the exhaust valve using a hot pad.

5. Disinfect the working surface with Lysol spray disinfectant or alcohol.

6. Wash your hands.

8.6 Processing the Sample for Fecal Coliform Testing

1. Remove the cover of the Petri dish and place up side down on the lab surface. It is important to make sure that you do not touch the inside of the Petri dish at any time.

2. Label the bottom of the Petri dishes (the smaller plate) with paper tape and a permanent marker. Identify the sample site number, date and tide on the tape.

3. Aseptically place a sterile absorbent pad into the bottom of the Petri dish, by using the sterile pad dispenser. Twist the cap off the plastic ampoule of MB Broth. Squeeze the nutrient medium onto the absorbent pad. **It is not necessary to get every drop of the medium into the dish.**

4. Sterilize a pair of forceps by dipping them open into a container of alcohol and then flaming them. Using the sterile forceps, place a membrane filter on the steel support of the filtration assembly. Keep the filter flat, grid side up, and discard the blue protective paper. Place the funnel over the filter. Rinse a little buffer solution into the funnel and allow it to drip into the glass base. Check for leaks. If there is a leak, remove the funnel and reattach.

5. Run a start blank (labeled SBI) by filtering a bottle of buffer solution to test the setup for possible contamination. Repeat this step (labeled SB II).

6. Shake the bag containing the sample by inverting 20-30 times to thoroughly mix. Open the sample bag and pipette the desired dilution amount (See Figure 8.6-1) into a fresh bottle of buffer solution.

7. Slowly pour the diluted sample into the filter funnel.

8. Filter the sample using a vacuum pump or hand pump. When the water is completely filtered, rinse the inside of the funnel with a new bottle of phosphate buffer solution. This ensures that all of the *Fecal coliform* bacteria washes onto the filter.

9. Use alcohol and flame to sterilize forceps before lifting membrane from filter. After lifting the funnel, remove the membrane filter from the support with sterile forceps. Place the filter onto the absorbent pad in the Petri dish grid side up.

> The filter should be placed on the absorbent pad using a “rolling action”, touching one end first and proceeding to the other side. Be careful to avoid trapping air bubbles under the membrane.

10. Replace the cover of the Petri dish and tap the bottom of the dish to help the nutrient medium to go into the membrane.

11. Between each sample, sterilize the funnel and filter for three minutes in the UV light box. Sterilize the filter forceps using alcohol and flame after each use.

12. Wash your hands between each sample.

13. Run a blank filtration of buffer in the middle of the testing samples as a negative control (labeled MB). This will allow for the data before the middle test to be valid in case the end control came up positive. To ensure quality, a second filtration must be performed for 10% of the samples by duplicating a sample dilution every 10 samples in order to ensure that results can be replicated.

14. Enclose the Petri dishes in a tightly closed Whirlpak bag that is labeled with the sample information. Place two dishes in each bag.

15. Slide the bags into the Petri dish rack. Place the Petri dishes upside down to ensure condensation does not ruin the sample. Submerse the rack in a water incubator set at 44.5 °C and let the samples incubate for 24 hours.

16. After 24 hours (+/- two hours), remove the dishes and count the number of colonies with a blue, metallic sheen which have grown on the filter paper. Use a dissecting microscope set at 10X, if available. This count gives an approximation of the number of fecal coliform bacteria in 100 mL of water.

17. For each sample, record the number of colonies per 100 mL sample on the data sheet. Use this formula:

$$\frac{(\#\text{ of colonies}) \times (100\text{mL})}{\#\text{ of mL used in sample}} = \text{colonies/100mL}$$

The accepted range for colonies to be counted on a membrane filter is 20-80 colonies. If you have more than 200 colonies, use a smaller dilution or write TNTC (i.e., too numerous to count) on the data sheet.

There might be some other colonies present on the filter besides the blue colonies with the metallic sheen. These other colonies are most likely to be yellow. They are bacteria other than fecal coliform bacteria. Do not include them in your count on the data sheet.

If colonies do not look rounded, the water was not completely filtered.

If there is a ring around the filter, you probably did not have the filtration assembly closed properly.

18. When you are finished counting the colonies, sterilize the Petri dishes, absorbent pad and filter for 35 minutes at 17 psi.

19. After sterilizing the Petri dishes, dispose of the pad and filter properly, and wash in plain, hot water.

Table 8.6-1: Suggested Sample Volumes for Membrane Filter Fecal Coliform Test (taken from "Standard Methods")

Site Number	Site Name	Tide	100 mL	50 mL	10 mL	1 mL
1	Oyster River Peninsula	H		X	X	
		L	Dry	X	X	
2	Jackson Laboratory	H	X			
	(JEL)	L	X			
3	Lamprey River	H		X	X	
		L	Wet	X	X	
4	Depot Road, Sandy Point	H	X	X		
5	Portsmouth Country Club	H	X	X		
	(PCC)	L		X	X	
6	Fox Point	H	X			
		L	X			
7	Cedar Point	H	X			
		L	X	X		
9	Cochecho River	H	Wet	X	X	
		L	Wet	X	X	
10	Piscataqua River	H	X	X		
		L	X	X		
11	Coastal Marine Lab	H	X			
	(CML)	L	X			
12	Sewage Treatment Plant	H		X	X	
	(NSTP)	L		X	X	
13	Marina Falls Landing	H	X	X	Wet	
		L	X	X		
14	Fowler's Dock	H	X	X		
		L	X	X		
15	Patten Yacht Club	H	X			
		L	X			
16	Exeter Docks	H		X	X	Dry
		L		X	X	
17	Dover Foot Bridge	H		X	X	
		L		X	X	
18	Maplewood Avenue	H		X	X	
		L	X	X		
19	Woodbury Avenue	H		X	X	Dry
		L		X	X	
20	Junkin's Avenue	H		X	X	X
		L		X	X	X
21	Pleasant Avenue	H		X	X	Dry
		L		X	X	Dry

9.0 Delivery and Clean-Up

9.1 Delivery

Once sampling is completed for the day, deliver the fecal coliform sample in a cooler with a cold pack along with your data sheets to Kingman Farm to arrive no later than 6:00 p.m. If you are not able to do so, either make sure someone else on your team delivers them, or call Ann at Kingman Farm (603)749-1565 or at home (603)749-3880 to arrange for pick-up. Please make these arrangements prior to the sampling day.

9.2 Clean-Up

At the end of the sampling day you should do the clean-up work necessary to make sure that the kit is ready for the next month's sampling activities. Removing the corrosive salt water also helps to extend the life of the equipment. This requires that you do the following:

1. Make sure the kit has been cleaned with fresh water and dried as provided for in the preceding test procedures.

2. Renew the pH kit as follows:

    a) Discard the "Rinse pH 7Buffer" solution.
    b) Wash and dry the "Rinse pH 7 Buffer" container.
    c) Pour the used test pH 7 buffer solution into the "Rinse pH 7 Buffer" container.
    d) Wash and dry the "Test pH 7 Buffer" container.
    e) Fill the "Test pH 7Buffer" container with new test pH 7 buffer solution from the "Extra test pH 7 buffer" container.

3. Refill the tap water container with fresh tap water.

4. Inventory the kit using the equipment check list to make sure that all components are in good condition and take note of any chemicals or supplies that need to be replenished. Likely candidates for replenishment are:

    a) Field Data Sheets
    b) Sodium Thiosulfate
    c) Test pH 7 Buffer Solution
    d) Manganese Sulfate Pillows (pillow #1)
    e) Iodide-Azide Pillows (pillow #2)
    f) Sulfamic Acid Pillows (pillow #3)
    g) Starch Solution
    h) Whirlpak Bags
    i) Permanent Marker
    j) Batteries
    k) Burette Parts

5. Replenishment of supplies is best done sampling day or at business meetings.

REFERENCES

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2. Anne Arundel County, Office of State Planning and Zoning, Annapolis, Maryland. ***1986 Citizen Monitoring Water Quality Monitoring Manual***. Pages 3, 4, Introduction.

3. Maine/New Hampshire Sea Grant Marine Advisory Program and University of Maine; Orono, Maine. Nov. 1992. ***Clean Water: A Guide to Water Quality Monitoring***. Pages 47, 48, 49.

4. New Hampshire Office of State Planning, Linda Maxson, Jackson Estuarine Laboratory. 1989. ***Great Bay National Estuarine Research Reserve Management Plan***. Page 7.